A GENETIC ANALYSIS OF TASTE DEFICIENCY IN THE AMERICAN NEGRO[1]

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The establishment of the unit character nature of taste deficiency for phenyl-thio-carbamide by Snyder (1931–1932) and Salmon and Blakeslee (1931), following Fox's original discovery that taste deficiency actually existed, is one of the more recent developments in the study of human inheritance. The studies of these authors on the inheritance of taste deficiency in man have been confined for the most part to American whites.

Preliminary data collected by the writer on the inheritance of taste deficiency in negroes indicated racial differences in the frequencies of the dominant and recessive genes for taste of phenyl-thio-carbamide. The present attempt at a more extensive and critical analysis of the character in the American negro is an outgrowth of the earlier investigation.

A human character which occurs with a fair frequency in a given population, should be analyzed beyond a mere inspection of the family histories. Although we may evolve a reasonable hypothesis of its hereditary nature from observation, the final proof of the nature of the inheritance must lie in the mathematical analysis of the data on the frequency basis. This mathematical consideration of the frequencies of the allelomorphic genes enables us to predict the proportions of the various kinds of offspring to be expected from the various kinds of matings.

The value and reliability of the figures thus obtained will depend on several criteria, among them the number of individuals studied. This point is taken care of in the probable error. Among other criteria that must be considered are mistakes in technique. Fortunately the character in question is easily determined. The subject either reports a bitter taste or no taste at all is recorded. As a further precaution, all non-tasters were given a second and third sample of the compound.

[1]Prepared in the genetics laboratory of the Ohio State University, under the direction of Dr. L. H. Snyder.

The crystals were placed on the posterior dorsum of the tongue, in the region of the more sensitive bitter taste buds. The tests include negroes of all ages and both sexes, since recent research has shown that age and sex as well as alkalinity and acidity of the saliva have no effect upon taste deficiency.

A further criterion is the randomness of the sample. The sample in question consists of 3,156 negro individuals, of which 500 were taken from southern schools. The remaining portion is made up of persons taken at random from the negro population of Ohio. The family data and a large number of individuals were collected by the writer and aids in the vicinity of Columbus, Ohio. While a more random sample is possible particularly from the southern states, the present sample serves reasonably well as representing the negro population, since a large number of the northern negro families are recently from the south.

As a final criterion, in checking the validity of the figures, a condition of stable equilibrium must be shown. In the absence of selection a new autosomal factor introduced into a population will produce a condition of stable equilibrium after one generation of random mating. In view of the fact that crossing is still taking place to some extent, as well as some selective mating within the hybrid group, the negro population is not altogether the result of random mating and is consequently not at absolute equilibrium. Therefore any deviations of the observed from the calculated proportions (other criteria being accounted for) may be attributed to continued intermixture as well as some selective mating within the hybrid group.

In order to obviate the need of distinguishing between homozygous and heterozygous dominants in man we apply the frequency method (Snyder, 1932, 1934).

The values below are derived from 3,156 negroes of which 291 (.092) are non-tasters. This is a significantly smaller proportion than that found in the white race (.298 non-tasters).

Assuming taste deficiency to be a simple recessive character and designating the two allelomorphs as T and t respectively,

Let p = frequency of T

and q = frequency of t.

then $p + q = I$, and $p^2 + 2pq$ = tasters (A)

q^2 = non-tasters (B)

$q \sqrt{B}$.

For this sample $q = .305$ and $p = .695$.

The total sample of 3,156 negroes includes 124 families. This group consists of 509 individuals of which 60 are non-tasters. For the family group, A = .883 and B = .117, and

$q = .343$

$p = .657.$

The probable errors for the ratios of the tasters and non-tasters in the family group and the total sample are as follows:

TABLE I

Sample	Non-Tasters
Total sample	.092 ± .003
Family group	.117 ± .009
Difference	.015 ± .009

The difference in the ratios of tasters and non-tasters in the family group and the total sample is less than three times its probable error. Consequently it is not considered a significant difference, and we may accept the family group as a representative one.

The following chart is a summary of the 124 families studied for the inheritance of taste deficiency for phenyl-thio-carbamide. The sample consists of 509 parents and children.

TABLE II

Matings		Children	
		Tasters	Non-Tasters
Taste × Taste	no.	184	18
	obs.	.9109 ± .013	.0891 ± .013
	calc.	.9350 ± .006	.0650 ± .006
	dev.	.0241 ± .014	.0241 ± .014
Taste × Taste deficient	no.	49	12
	obs.	.7646 ± .026	.2354 ± .026
	calc.	.7451 ± .007	.2549 ± .007
	dev.	.0195 ± .026	.0195 ± .026
Taste deficient × Taste deficient	no.	0	2
	obs.	0.000	1.000
	calc.	0.000	1.000
	dev.	0.000	0.000

From the above table it can be seen that the deviations of the observed proportions from the expected proportions are less than three times their probable errors. As a final check, the observed values for the proportions of tasting and non-tasting offspring of the various matings were compared with the expected proportions on the basis of the p and q ratio from the total sample. The results are shown in Table III.

Here again the observed proportions are near enough the expected proportions to establish the unit character nature of taste deficiency for phenyl-thio-carbamide.

In spite of the fact that intermixture as well as selection within the negro group is taking place, Tables II and III

TABLE III

Matings		Children: Tasters	Children: Non-Tasters
Taste × Taste	obs.	.9109 ± .013	.0891 ± .013
	calc.	.9485 ± .001	.0542 ± .001
	dev.	.0349 ± .013	.0349 ± .013
Taste × Taste deficient	obs.	.7646 ± .026	.2354 ± .026
	calc.	.7673 ± .003	.2327 ± .003
	dev.	.0027 ± .026	.0027 ± .026
Taste deficient × Taste deficient	obs.	0.000	1.000
	calc.	0.000	1.000
	dev.	0.000	0.000

indicate that an equilibrium in regard to the taste genes has been fairly well established. Since the frequencies in the original negroes and whites undoubtedly differ greatly, a rather high degree of random mating is necessary to approach the equilibrium that the sample in question indicates. Unfortunately repeated attempts to obtain taste results from West Africa in the region of the forest negroes were of no avail. The only results obtained from Africa were one set from East Africa, and one group from the Egyptian Sudan.

Table IV is a summary of the gene frequency ratios for taste deficiency in the races thus far studied.

In this table the Kenya negroes are not to be looked upon as a true representation of the original negroes brought to America. This group is from East Africa and shows traces of admixture with non-negroid stocks (Hooton, 1931).

The forest negroes, particularly those from the Guinea coast of West Africa, in a large measure made up the parent negro population of America. No results were returned from samples of the compounds sent to this group.

The mixed Indian sample does show the effect of crossing with the whites. The non-tasters increase from .060 in full blooded Indians to .106 in mixed Indians. The American

TABLE IV

Collectors	Sample	No.	Tasters	Non-Tasters	P	Q
Snyder (1932)	American whites	3643	.702	.298 ± .005	.455	.545
Levine and Anderson (1932)	Pure American Indians	183	.940	.060 ± .011	.765	.244
Levine and Anderson (1932)	Mixed American Indians	110	.896	.106 ± .019	.674	.336
Lee	American negroes	3156	.907	.092 ± .003	.697	.305
Lee	Kenya Negroes	110	.919	.081 ± .017	.716	.284
Lee	Egyptian Sudan Natives	805	.958	.042 ± .001	.795	.205

negro group presents an increase in the proportion of non-tasters of .011 over the Kenya group, and .050 over the Egyptian Sudan natives, and falls between the American whites on the one hand and the Kenya and Egyptian groups on the other hand. The pure blooded Indians show the lowest proportion of non-tasters. However, the mixed group presents a higher proportion of non-tasters than the American negro sample. This higher percentage might easily be accounted for on the basis of social selection. The action of the social forces of the American people allow for crossing of American Indians and whites more readily than that of negroes and whites. There is, however, considerable doubt that the three smaller samples are truly representative of their respective groups.

This uneven distribution of non-tasters among whites, negroes, and Indians leads to the assumption that a recessive mutation for taste deficiency arose in that group which today presents the highest percent of non-tasters, i. e., the Caucasians. The non-tasters among the negroes and Indians being distinctly low might lead one to believe that they were all originally homozygous tasters, and the recessive factor came about through infiltration with the Caucasians. While such an explanation seems plausible further genetic analysis of human populations is necessary before any conclusions can be drawn.

The analysis of threshold values and the effects of temperature on the various taste reactions are in progress in the laboratory, for the negro groups as well as for the white groups. These results will be published later.

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